FOCUSED REMOVAL ACTION ALTERNATIVE EVALUATION REPORT
FORMER WESTERN TAR FACLITY-TIE STORAGE AREA
TERRE HAUTE, VIGO COUNTY, INDIANA

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION V
77 West Jackson Boulevard
Chicago, Illinois 60604

Prepared by

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Vernon Hills, Illinois 60061

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ACRONYMS AND ABBREVIATIONS

amsl	Above mean sea level
bgs	Below ground surface
bss	Below sediment surface
BTEX	Benzene, toluene, ethylbenzene, xylene
CAVU Ops.	CAVU Ops. Inc.
cm/s	Centimeters per second
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CY	Cubic yard
DNAPL	Dense non-aqueous phase liquid
ESL	Ecological Screening Level
ft	Feet, foot
ft^2	Square foot
gpd	Gallons per day
gpm	Gallons per minute
GRA	General Response Action
IDCL	Commercial/Industrial Default Closure Levels
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
KERAMIDA	KERAMIDA Inc.
µg/L	Microgram per liter
mg/kg	Milligram per kilogram
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PRP	Potentially responsible party
QA	Quality assurance
QC	Quality control
RAO	Removal Action Objective
RCRA	Resource Conservation and Recovery Act
RISC	Risk Integrated System of Closure
RDCL	Residential Default Closure Level
SI	Site Investigation
SS	Sediment sample
START	Superfund Technical Assessment and Response Team
SVOC	Semivolatile organic compound
SY	Square Yard
TDD	Technical Directive Document
UTM	Universal Transverse Mercator
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile organic compound
VRP	Voluntary Remediation Program
WESTON	Weston Solutions, Inc.
WTS	Western Tar Site

1. INTRODUCTION

Weston Solutions, Inc. (WESTON®) has prepared this Focused Removal Action Alternative Evaluation Report (Focused Removal Action Report or FRAR) for the former Western Tar Corporation facility tie storage area (Site) located in Terre Haute, Vigo County, Indiana (**Figure 1-1**) for the United States Environmental Protection Agency (U.S. EPA) under the Superfund Technical Assessment and Response Team (START) III contract EP-S5-06-04, Technical Directive Document (TDD) No. S05-0001-0910-005.

1.1 PURPOSE

The purpose of this FRAR is to develop and evaluate removal action alternatives for the Site based on information and data collected as part of the Site Investigation Report, Wabash River Bank Mitigation (KERAMIDA Inc., 2011). Removal action alternatives can involve the following: (1) natural attenuation; (2) destruction of contaminants or a reduction in their volume, toxicity, or mobility; and (3) reduction of exposure pathways.

1.2 REPORT ORGANIZATION

This FRAR consists of the sections summarized below:

- **Section 1, Introduction**: Provides a brief overview of the purpose and scope of the FRAR and discusses the report organization.
- **Section 2, Site Background and History**: Summarizes the Site description, history, environmental setting, and investigation activities completed to date, and defines the extent of contamination.
- **Section 3, Development of Removal Action Objectives**: Describes the process used to develop Removal Action Objectives (RAOs) and identifies the general response actions (GRAs) for soil treatment.
- **Section 4, Development of Alternatives**: Combines technologies based on the GRAs identified in Section 3 into removal action alternatives that address RAOs for soil at the Site and provides detailed descriptions of each alternative.
- **Section 5, Screening of Alternatives**: Screens the alternatives based on the criteria of effectiveness, implementability, and cost.
- **Section 6, References**: Lists the references used to prepare this document.

A table of comparative data (Table 2-1), figures, and appendices are presented after Section 6.

2. SITE BACKGROUND AND HISTORY

This section summarizes the Site description, history, environmental setting, and investigation activities completed to date.

2.1 SITE DESCRIPTION

The former Western Tar Corporation facility is located at 2525 Prairieton Road, Terre Haute, Vigo County, Indiana. The entire site consists of approximately 22 acres located in the southeast quarter of the east half of Section 32 of Range 9 West, Township 12 North as shown in Fig.1.

The Site was operated as a wood-treating facility beginning in approximately 1906. CAVU Ops., Inc. (CAVU Ops.) currently owns the property. Tangent Rail Corporation (Tangent) formerly leased the property and operated the Site as a wood-treating facility. Tangent was purchased by Stella-Jones, Inc. in 2010. Stella-Jones moved production to other facilities and is currently decommissioning the facilities at the Site.

Wood-treatment operations reportedly occurred in the Process Area at the north end of the Site (north of I-70). However, this FRAR addresses only the former tie storage area at the south end of the Site. Historically, according to CAVU Ops., the south end of the Site was only utilized for the storage of untreated railroad ties. The north and south portions of the Site are separated by Interstate I-70 (see **Figure 2-1**). The southern portion of the Site is bordered on the west by a steep bluff that runs along the Wabash River and the east by Prairieton Road. Coal tar materials have been identified emanating from the east bank of the Wabash River at the south end of the Site. The Process Area at the north end of the Site was admitted to the Indiana Department of Environmental Management (IDEM) Voluntary Remediation Program (VRP) in 1999 and is being addressed through the VRP.

2.2 ENVIRONMENTAL SETTING

This section discusses the Site's geographic, geologic, and hydrogeologic setting. Unless otherwise noted, environmental setting information was obtained from the Site Investigation Report, Wabash River Bank Mitigation (KERAMIDA Inc., 2011).

2.2.1 Geographic Information

The Site is located in a mixed industrial and residential area in the southern portion of Terre Haute, Indiana. Location information for the Site is presented below:

Township: 12N (Harrison)
Range: 9W
Sections: 32 (NE ¼ of SE ¼) and 33 (NW ¼ of SW ¼)
Latitude: N 39° 26' 22.1"
Longitude: W 87° 25' 29.7"
UTM: Zone 16S
North - 4365631.39
East - 0463435.91

2.2.2 Geologic Setting

2.2.2.1 *Regional*

Regional geologic information was obtained from the Quaternary Geologic Map of Indiana (Gray, 1989), the Bedrock Geologic Map of Indiana (Gray et al., 1987), and the Map of Indiana Showing Thickness of Unconsolidated Deposits (Gray, 1983). These maps indicate that Terre Haute is underlain by the Carbondale Group consisting of Pennsylvanian shale and sandstone. The Site is located on the eastern flank of the Illinois Basin. Bedrock slopes west and southwest into the basin. Bedrock is present at a depth of approximately 130 feet (ft) below ground surface (bgs). The Site is underlain by undifferentiated glacial outwash of the Atherton Formation. The outwash is composed of sand and gravel. A thin layer of alluvium is present at the surface. The unconsolidated deposits are composed of coarse-grained alluvial sediments and fine-grained floodplain sediments underlain by coarse glaciofluvial outwash deposits. These deposits generally consist of sands and gravels.

2.2.2.2 *Site-Specific*

The eastern portions of the Site, which include the south end and Process Area, have a ground surface elevation of approximately 490 ft above mean sea level (amsl). The topography of the eastern portions of the Site is relatively flat. The western portions of the Site extend into the Wabash River floodplain to the north and its bank to the south because of a sharp bend in the river that runs east then cuts south along the southerly portion of the Site. A rip-rap dike is constructed along portions of the steeply sloped bank.

Soil textures underlying the south end of the Site generally consist of a layer of fill overlying sandy loam to loamy sand to approximately 5 to 8 ft bgs underlain by sand and gravel. In the Process Area at the north end of the Site, sand and gravel extend to a depth of 117.8 ft bgs. Siltstone bedrock was encountered beneath the sand and gravel unit. Unconfined groundwater in the Process Area is encountered in the sand and gravel at depths ranging from approximately 38 to 45 ft bgs depending on the topographic elevation of the location.

2.2.3 Hydrogeologic Setting

2.2.3.1 *Regional*

The largest aquifer in the area is the water-bearing sand and gravel deposits associated with the present and pre-Pleistocene valleys of the Wabash River. The sand and gravel forms a continuous hydrogeologic system in which both water table and artesian characteristics are present. The aquifer is unconfined in the area near the Wabash River. Wells yielding greater than 2,000 gallons per minute (gpm) are possible in the aquifer.

City water is provided to the Site and the immediate vicinity. However, water supply wells are also located in the area and may still be used for potable or other purposes. According to water well records available from the Indiana Department of Natural Resources (IDNR), the closest water well is owned by Western Tar Products (currently CAVU Ops., Inc., (operated by

Tangent) and is located on-site. The on-site well is 6 inches in diameter, completed to 103 ft bgs, and screened from 85 to 100 ft bgs. According to a Significant Water Withdrawal Facility Registration for the Site, the well is a production well used to supply cooling water and boiler water. Total withdrawal capacity of the well is reported to be 108,000 gallons per day (gpd).

An additional 20 wells are located within ¼ mile, 19 of which are owned by International Paper located on the north adjacent property. Of the 19 wells, six are listed as high capacity, two are listed as industrial without a capacity, five are listed as test wells with no capacity, and six have neither documented use nor capacity information (KERIMIDA 2011). This International Paper facility in Terre Haute is no longer in operation and was recently decommissioned. The current status of the International Paper wells is not known. The remaining well within ¼ mile is located at a liquor store at 2710 Prairieton Road. The well is listed as home use, but no capacity is provided. The wells range in depth from 100 ft to 128 ft screened from approximately 80 ft except for the liquor store well, which is 59 ft deep with 5 ft of screen. All the wells are screened in sand and gravel.

A total of 42 wells were identified in the ¼-mile to 1-mile radius. Of these wells, 12 are high capacity (one home, one public, eight industry, one irrigation, and one with no use listed). Of the low-capacity wells, eight are listed as home, seven as industry, five as test, two as public, three as other, and five have no use listed. The home wells typically are 50 to 60 ft deep and are screened in sand or sand and gravel. The remaining wells generally are 60 to 130 ft deep and are screened in sand or sand and gravel. The geologic profiles are very consistent with various grades of sand or sand and gravel throughout the explored depth.

A total of 15 high-capacity wells were identified in the 1-mile to 2-mile radius. Of these, eight are industrial, two have no use listed, and the remaining include one in each of the following use categories: home, public, test, irrigation, and other. Well construction and geology are similar to that described above.

2.2.3.2 *Site-Specific*

Unconfined groundwater is encountered in the sand at depths ranging from approximately 38 to 45 ft bgs depending on the topographic elevation of the location. Historically in the Process Area, groundwater has flowed to the west-northwest toward the Wabash River. The hydraulic gradient has typically ranged from 0.001 to 0.005, but has been observed as high as 0.03.

KERAMIDA Inc. (KERAMIDA), of Indianapolis, Indiana, environmental consultant to CAVU Ops., collected soil samples and completed hydraulic slug testing in the Process Area to evaluate the site-specific geologic and hydrogeologic properties of the sand and gravel outwash present at the Site. Two samples were collected from the upper loamy unit and two samples were collected from the lower sand unit. Samples were collected downgradient of dense non-aqueous phase liquid (DNAPL) occurrence in the Process Area. Samples were submitted for soil permeability testing and grain size analysis. The soil permeability results for the upper loamy unit were 1.3×10^{-3} centimeters per second (cm/s) for both samples, and 2.0×10^{-2} cm/s and 1.5×10^{-3} cm/s in the lower sand unit. Results of the grain size analysis indicate both units are sand with gravel.

Hydraulic slug tests were conducted in on-site wells MW-1, MW-21, MW-24, and MW-26 in and around the Process Area as part of the IDEM VRP project in the Process Area. The average hydraulic conductivity for each well ranged from 1.86×10^{-2} cm/s at MW-1 to 9.83×10^{-3} cm/s at MW-26. The average hydraulic conductivity within the sand and gravel outwash aquifer is approximately 1.37×10^{-2} cm/s or 38.81 ft per day. The average hydraulic conductivity calculated for the sand and gravel outwash deposits at the Site is consistent with values of similar unconsolidated sand and gravel outwash deposits, as indicated in Freeze and Cherry (1979).

Based on an average hydraulic conductivity of 39 ft/day, an average hydraulic gradient of 0.003, and an assumed effective porosity of 25%, the average groundwater flow velocity across the Site is approximately 0.5 ft/day or 180 ft/year.

2.3 PREVIOUS INVESTIGATIONS

An anonymous fisherman called the IDEM in June 2009 and reported that black material was seeping from the banks of the Wabash River into the river. The U.S. EPA and IDEM responded to the anonymous report and confirmed apparent coal tar presence along the east bank of the Wabash River along the southern boundary of the Site. KERAMIDA representing CAVU Ops., further investigated the reported presence of coal tar materials on the east bank of the Wabash River. Subsequent sampling investigations have been performed between 2009 and 2011 as summarized in the sections that follow.

2.3.1 Site Investigation, July and August 2009

In July 2009, KERAMIDA performed a site investigation to collect soil and surface water samples and to remove coal tar material from the riverbank. During the investigation, apparent coal tar material was observed intermittently along an approximate 400-ft section of the riverbank. In at least one location the material was in contact with the Wabash River. On July 13, 2009, KERAMIDA used hand tools to remove the coal tar material from the riverbank in the location that extended into the river. Three surface water samples were collected from the Wabash River, two samples upstream and one sample downstream from the coal tar-impacted section of the riverbank. The samples were denoted as "Upstream#1 Fairbanks Pave," "Upstream#2 Near Impacts," and "Downstream." KERAMIDA also collected two soil samples denoted as "Dark Soil – South of Tar Flow" and "Soil Directly under Tar Flow" from soil located beneath the coal tar seep. The soil and surface water samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs).

Two SVOCs, pyrene and acenaphthylene, were detected in the "Upstream#1 Fairbanks Pave" surface water sample taken closest to the area where the coal tar was seeping into the river. Pyrene was detected at 1.06 micrograms per liter (µg/L), exceeding the U.S. EPA Region 5 Resource Conservation and Recovery Act (RCRA) Ecological Screening Level (ESL) of 0.3 µg/L. Acenaphthylene was detected in this sample at 1.13 µg/L, but did not exceed the applicable surface water thresholds.

Concentrations of contaminants detected in soil were compared to the IDEM Risk Integrated System of Closure (RISC) Residential Default Closure Levels (RDCLs) for soil. None of the detected concentrations exceeded the RDCLs.

KERAMIDA also completed subsequent removal activities of visible coal tar-impacted material, which was removable by hand and/or hand tools from the riverbank areas during the period of August 10 to 20, 2009.

Following additional correspondence between KERAMIDA and U.S. EPA, further investigation was recommended that included excavating test pits to a depth of approximately 6 ft bgs, installing soil borings at least 5 ft below the water table, and performing additional sediment sampling in the Wabash River.

2.3.2 Site Investigation, 2011

The 2011 Site Investigation (SI) was designed to accomplish the following: i) determine the extent of coal tar on the property south of I-70; and ii) confirm there is no subsurface connection between coal tar occurrence identified in the "Process Area" and the coal tar occurrence identified along the east bank of the Wabash River in the southern portion of the Site. Each investigation location was identified by a code corresponding to the sample type:

KB – KERAMIDA Soil Boring
TT – Test Trench (Pit)
SS – Sediment Sample
WTS-SS – WESTON START Sediment Sample

The sections that follow present a summary of the investigation and sampling results.

2.3.2.1 *Test Trench and Soil Boring, January 2011*

KERAMIDA performed soil boring and test pit field activities during the period of January 25 to 31, 2011. KERAMIDA completed seven test pits (TT-101, TT-104, TT-107, TT-109, TT-111, TT-114, and TT-117) at the Site on January 26, 2011 (**Figure 2-2**). The test pits were excavated to depths of approximately 6 ft bgs. The test pits were oriented north-south and were approximately 2 ft wide. Representative samples of soil or coal tar material, as encountered, were collected for contaminants of potential concern (COPCs) benzene, toluene, ethylbenzene, xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), and 2-chloronaphthalene analysis.

KERAMIDA completed push-probe drilling at 11 soil borings on January 26 to 28, and January 31, 2011. The following soil samples were submitted for analysis of BTEX, PAHs, and 2-chloronaphthalene:

- KB-102 (42 to 44 ft bgs)
- KB-103 (16 to 18 ft bgs)
- KB-103 (40 to 41 ft bgs)
- KB-105 (13 to 14 ft bgs)
- KB-106 (13 to 14 ft bgs)
- KB-110 (40 to 42 ft bgs)
- KB-112 (38 to 38.75 ft bgs)
- KB-113 (1 to 2 ft bgs)
- KB-115 (42 to 42.5 ft bgs)
- KB-116 (36 to 37 ft bgs)
- KB-118 (40 to 41 ft bgs)
- KB-120 (40 to 41 ft bgs)

An additional 14 borings were advanced to visually delineate the coal tar material occurrence identified in soil boring KB-113 and test pits TT-101 and TT-107. Soil borings KB-101-N, KB-101-S, KB-101-E, and KB-101-W were advanced to a depth of 8 ft bgs around test pit TT-101 for visual screening. Soil borings KB-107, KB-121, KB-122, KB-123, and KB-124 were advanced to a depth of 8 ft bgs near test pit TT-107 for visual screening. Soil borings KB-113-1N, KB-113-2N, KB-113-3N, KB-113-E, and KB-113-S were advanced to a depth of 8 ft bgs around soil boring KB-113 for visual screening.

The analytical data were compared to the IDEM RISC Commercial/Industrial Default Closure Levels (IDCLs). The soil boring and test trench analytical results compared to IDEM RISC IDCLs are presented on **Table 2-1**. Except for sample KB-113, the COPCs were not detected at concentrations exceeding IDCLs in any of the soil borings. However, KB-113 was the only near-surface sample collected at the Site. All other soil boring samples were collected at depths ranging from 13 to 44 ft bgs. COPCs were detected at concentrations exceeding the IDCLs in the near-surface soil sample (1 to 2 ft bgs) collected of the coal tar material encountered in KB-113 and from samples collected at all seven test pit locations. COPCs were detected in surface and near-surface soil samples (generally within the top 2 ft) collected from the test pits. As shown on **Table 2-1**, concentrations of COPCs exceeded the direct contact and migration to groundwater IDCLs at locations KB-113, TT-101, TT-107, and TT-114. Concentrations of several COPCs also exceeded soil attenuation capacity levels at TT-107. The sample from test pit TT-107 was collected from the coal tar material encountered throughout the depth of the pit. The sample was collected near the base of the pit (4.8 to 5 ft bgs). Direct contact IDCLs were also exceeded at TT-104, TT-109, and TT-117. The only test pit sample that did not exhibit COPCs at concentrations exceeding IDCLs was TT-111. The TT-111 sample was collected from 1.25 to 1.5 ft bgs right below the surface layer labeled as "chip and seal." The sample collected from TT-111 contained detectable levels of COPCs one of which, benzo(a)pyrene, was just below the IDCL.

Pavement-like material and a gravelly sub-base (chip and seal) were observed as present at the surface of the Site, in the test pits and many of the borings. According to CAVU Ops., the "chip and seal" is a combination of a distilled coal tar-based primer (RT-2) and distilled coal tar-based base coat (RT-10). COPC occurrence above screening levels in surface and near-surface soil appears to be related to "chip-and-seal material" at these locations. Samples collected from TT-104 (0.75–1.0 ft bgs) and TT-117 (0.5–0.75 ft bgs) are most representative of the chip-and-seal material based on the depth of the samples and the description presented on the boring logs presented in the Site Investigation Report, Wabash River Bank Mitigation (KERAMIDA Inc., 2011). PAHs were detected at concentrations exceeding direct contact IDCLs at locations TT-104 and TT-117.

2.3.2.2 *Wabash River Sediment and Riverbank Coal Tar Sampling, July 2011*

Following the test trench and soil boring sampling, WESTON START and KERAMIDA conducted sediment and coal tar sampling activities along the Wabash River on July 13, 2011.

Sediment sampling was delayed until July because of flooding and high water conditions in the spring and early summer.

Following review of the draft Work Plan, U.S. EPA requested up to six river transect locations: one upstream and three to five downstream. However, KERAMIDA proposed only three transects in the final Work Plan (KERAMIDA Inc., December 3, 2010): one upstream and two downstream. Therefore, U.S. EPA had WESTON START collect sediment cores from two additional transects adjacent to the Site. These locations were selected based on distribution of coal tar identified on the riverbank and to obtain a sufficient number of sediment samples to adequately characterize the extent of coal tar COPCs in the sediment. KERAMIDA collected sediment cores along its three planned transect locations, and elected to split sediment samples from the two additional WESTON START transects. WESTON START provided oversight for sediment samples collected by KERAMIDA from three transects. Three sampling points were planned at each transect: one near shore, the second mid-river, and the third opposite near shore with two sediment samples collected at each location from intervals of 0 to 6 inches and 6 to 12 inches below sediment surface (bss).

The presence of impenetrable materials such as cobbles and/or debris on the riverbed prevented the core sampler from advancing at several locations and resulted in consistent sediment refusal either at the sediment surface or within the 0- to 6-inch interval. Multiple attempts were made at each location by stepping out approximately 10 ft one direction or another from the proposed location. Moderate water opacity prevented clear riverbed visibility during sediment sampling activities. KERAMIDA collected 13 sediment samples (SS) from 11 of the 15 planned sampling locations with only two samples collected from the 0.5- to 1.0-ft interval because of refusal **(Figure 2-3)**:

- SS1 (transect 1) – 0 to 0.5 ft bss and 0.5 to 0.75 ft bss
- SS2 (transect 1) – 0 to 0.5 ft bss
- SS3 (transect 2) – 0 to 0.5 ft bss and 0.5 to 0.75 ft bss
- SS4 (transect 2) – 0 to 0.25 ft bss
- SS5 (transect 2) – 0 to 0.5 ft bss

- SS6 (transect 3) – 0 to 0.5 ft bss
- SS7 (transect 4) – 0 to 0.5 ft bss
- SS8 (transect 4) – 0 to 0.5 ft bss
- SS9 (transect 5) – 0 to 0.5 ft bss
- SS10 (transect 5) – 0 to 0.5 ft bss
- SS11 (transect 5) – 0 to 0.5 ft bss

WESTON START collected three Western Tar Site (WTS) sediment samples within the 0- to 6-inch bss interval prior to refusal from four of the six planned sampling locations with an additional sample taken at the upstream KERAMIDA baseline transect 5:

- WTS-SS06 (transect 3) – 0 to 0.5 ft bss
- WTS-SS07 (transect 4) – 0 to 0.5 ft bss
- WTS-SS08 (transect 4) – 0 to 0.5 ft bss
- WTS-SS09 (transect 5) – 0 to 0.5 ft bss

WESTON START also collected one coal tar product sample (WTS-FP) from one of the source areas along the Wabash River shoreline/overbank where the coal tar was sloughing off out of the bank and into the river (**Figure 2-3**). A photograph of this source area is shown in **Appendix A**.

Of the sediment collected, only sediment samples SS8 and WTS-SS08 were collected near the cut-bank portion of the river. In addition, a coal tar sample (WTS-FP) was taken from the cut bank of the river.

The WESTON START sediment and coal tar samples were analyzed for VOCs and SVOCs. The sediment samples collected by KERAMIDA were analyzed for BTEX, PAHs, and 2-chloronaphthalene.

Several PAHs were detected in the sediment samples. However, acenaphthene was the only chemical detected in Wabash River sediment at concentrations exceeding U.S. EPA RCRA ESLs. Acenaphthene exceeded the ESL of 0.00671 milligram per kilogram (mg/kg) in sample SS-11 collected upstream of the coal tar-impacted section of the riverbank.

2.4 EXTENT OF CONTAMINATION

During soil sampling activities, coal tar material was encountered within the riverbank and at KB-113, TT-101, and TT-107. Soil boring KB-113 and test pit TT-107 were advanced along the tree line near the riverbank and the area west of these locations could not be accessed with the drill rig due to the steep slope and the brush and trees on the riverbank. The coal tar occurrence at each location appears to be limited to the upper 6 ft of soil; however, the linear extent of contamination has not been defined. The area between KB-113 and TT-107 may be impacted with coal tar and is assumed to be impacted for purposes of defining the extent of contamination. Additional characterization by continuous exploratory trenching of the area of the bank between KB-113 and TT-107 may significantly decrease the estimated extent of coal tar contamination in this area.

The coal tar material encountered at TT-101 was not laterally defined by step-out borings KB-101-N, KB-101-S, KB-101-E, and KB-101-W. The estimated coal tar-impacted area surrounding TT-101 and the KB-101 step-out borings is 4,800 ft^2 (**Figure 2-4**). Based on an area of 4,800 ft^2 and a coal tar thickness ranging from 0.25 to 1 ft, the estimated volume of coal tar material in the vicinity of test pit TT-101 and KB-101 step-out borings is approximately 110 cubic yards (CY).

The coal tar-impacted area surrounding TT-107 is an estimated 40-ft by 40-ft area (**Figure 2-4**). Based on an area of 1,600 square feet (ft^2) and a coal tar thickness of 4.5 ft, the estimated volume of coal tar material in the vicinity of TT-107 is 270 CY.

As shown on **Figure 2-4**, coal tar was encountered in three areas along the riverbank. Based on an area of 5,600 ft^2 and a coal tar thickness of 2 ft, the estimated volume of coal tar material in the riverbank is 415 CY.

The estimated coal tar-impacted area surrounding the KB-113 borings is 4,000 ft^2 (**Figure 2-4**). Based on an area of 4,000 ft^2 and a coal tar thickness ranging from 1 to 2 ft, the estimated volume of coal tar material in the vicinity of KB-113 is 180 CY.

A chip-and-seal paving material and a gravelly sub-base were encountered at the surface of most of the test pit locations and some of the soil borings in the former untreated timber storage area. Occurrence of PAHs identified in surface and near-surface soils at these locations appears to be related to the chip-and-seal paving material. Some of the PAHs, specifically benzo(a)pyrene, identified in the samples associated with the chip-and-seal material are greater than 8 times the IDEM RISC IDCLs. According to the property owner (Mr. Card), the chip-and-seal paving material was placed in the former untreated timber storage area to assist in compliance with fugitive dust emissions regulations, to provide a smooth and stable surface for safely stacking ricks of timbers, and to provide weed control between the ricks. According to the Site Investigation Report (KERAMIDA Inc., 2011), "Pavement-like material and a gravelly sub-base (chip and seal) was present at the surface of the test pit locations. KERAMIDA verified with Mr. Card that the material was in fact chip and seal. Mr. Card indicted it was a combination of a distilled coal tar-based primer (RT-2) and distilled coal tar-based base coat (RT-10)." The extent of the chip-and-seal material with PAHs greater than the IDEM RISC IDCLs is assumed to include all areas of the Site without vegetation and areas formerly used for timber storage. The estimated areal extent of the chip-and-seal material is 146,500 ft^2 (**Figure 2-4**). Based on an estimated impacted depth of 1 ft bgs, the estimated volume of chip and seal-impacted soil is 5,030 CY.

Several PAH constituents were detected in Wabash River sediment during the SI activities. However, PAH constituents at low levels appear to be ubiquitous in the river sediment and are present at similar concentrations, whether at an upstream or downstream location. Photographs taken while obtaining a sample of the coal tar in the riverbank show chunks of coal tar material in the river in the near-shore sediment below the water surface (**Appendix A**). The extent of the coal tar material in the sediment has not been delineated because of poor or no recovery at the transect sampling locations along the near-shore cut bank immediately downstream of the riverbank coal tar areas. Further investigation of the extent of the coal tar material in the river should be conducted using sampling methods better suited to the nature of the material comprising the sediment in these locations. The assumption was that Lexan tubes would provide sufficient recovery; however, they proved to be somewhat ineffective for sample recovery, and ineffective for obtaining chunks of coal tar like those seen in the photographs (**Appendix A**). A Ponar dredge or similar apparatus would be more appropriate for sampling given the conditions discovered during the sediment sampling event. Removal of contamination of the Wabash River sediment is not included in this FRAR but may be addressed during future removal action, if deemed necessary.

3. DEVELOPMENT OF REMOVAL ACTION OBJECTIVES

This section presents the development of removal action goals and the identification of potential alterative response actions based on the removal action goals.

3.1 REMOVAL ACTION GOALS

Removal action goals are acceptable contaminant levels developed for each chemical constituent and exposure route. Removal action goals for protecting human receptors express both a contaminant level and an exposure route rather than contaminant levels alone because protectiveness may be achieved by reducing exposure (for example, by engineered or institutional controls) as well as by reducing contaminant levels.

Based on current land use of the Site and adjacent areas, it is assumed that the Site will retain industrial or commercial land use in the future. Based on current conditions and ownership, the receptor groups include the following:

- Current and Future Industrial Site Worker Exposure to Site Soil.
- Current and Future Recreational User (i.e., fisherman, etc.).
- Future Construction Worker Exposure to Site Soil.

Limited ecological receptor habitat is anticipated at the Site, which is a former commercial/industrial area. Thus, ecological benchmarks are not included as removal action goals in this FRAR.

The numeric removal action goals for Site soil are based on IDEM RISC IDCLs, which serve as cleanup levels protective of human health and the environment under commercial/industrial land use.

3.2 REMOVAL ACTION OBJECTIVES

Based on sampling data presented in **Table 2-1**, the Site contaminants of concern (COCs) primarily include PAHs. Based on the COCs, exposure pathways and receptors, and acceptable constituent levels, the RAOs for the Site are as follows:

- Prevent ingestion, inhalation, and direct human contact with soil containing COCs at concentrations that exceed the IDEM RISC direct contact IDCLs.
- Minimize infiltration and resulting contaminant leaching to groundwater from soil containing COCs at concentrations that exceed the IDEM RISC migration to groundwater IDCLs.
- Prevent migration of coal tar to the sediment of the Wabash River.
- Remove coal tar product.
- Control soil erosion of areas of contamination.

3.3 GENERAL RESPONSE ACTIONS

General response actions (GRAs) are actions that may be taken to satisfy the RAOs. The applicable GRAs for the Site are discussed in the sections that follow.

3.3.1 No Action

No action means that no removal action will be undertaken at the Site. The Site will remain in its current state, and no actions will be conducted to remove, isolate, or remediate the contamination. Under the no-action response, monitoring will not be conducted to assess changes in contaminant concentrations over time within the affected media. No additional access or deed restrictions will be put into place.

3.3.2 Institutional Controls

Institutional controls are non-engineering measures, usually legal or physical means, of limiting potential exposure to a site or medium of concern. Institutional controls prevent human exposure to the identified COCs but do not address reducing the toxicity, mobility, or volume of contamination. Examples of institutional controls include access restrictions, land use restrictions, resource use, deed restrictions, and monitoring.

The institutional control response typically includes government or regulatory actions or restrictions that may be taken to protect the public from short-term or long-term risks during or after a removal action.

3.3.3 Containment

Containment refers to technologies used to prevent or redirect the transport mechanisms from contact with contaminated media, and isolate contaminants from human and ecological contact. Containment limits the migration of contaminants beyond the present area of contamination into adjacent areas but does not contribute to reducing the toxicity or volume of contamination.

3.3.4 Collection

Collection activities consist of technologies to remove contaminated media or sources of contamination. One of the most common response actions is excavation of contaminated soil. The objective of collection is to permanently reduce or eliminate risks associated with the contaminated media. Adequate protection of human health and the environment is achieved by reducing the toxicity, mobility, or volume of the contaminated media through removal.

3.3.5 Treatment

Treatment processes reduce the toxicity, mobility, or volume of contamination either in situ or ex situ. Compounds either are removed or the chemistry of the contaminant molecule is altered by physical, chemical, or biological processes.

3.3.6 Disposal

Treated or untreated wastes can be disposed of either on or off site. Disposal options determine the ultimate location of treated or untreated media in an environmentally sound, publicly acceptable, and cost-effective manner. Disposal actions typically do not involve reduction of the toxicity or volume of contaminated media but may in certain circumstances reduce contaminant mobility because of associated containment. Soil disposal removes the source of risk to human health and the environment through the disposal of excavated soil, typically at a properly licensed and regulated disposal facility. These technologies would be used in combination with removal actions and ex situ treatment actions.

4. DEVELOPMENT OF ALTERNATIVES

This section presents the development of removal action alternatives to address contamination in soil at the Site. The objective was to develop alternatives that could achieve the RAOs identified in Section 3. The GRAs incorporated into the removal action alternatives include no action, institutional controls, containment, collection, treatment, and disposal.

4.1 ALTERNATIVE 1 – NO ACTION

A "No Action" alternative provides a baseline against which the other alternatives can be compared. The No Action alternative assumes that no removal action will be implemented at the Site and current condition of the Site will remain unchanged.

4.2 ALTERNATIVE 2 – EXCAVATION AND OFF-SITE DISPOSAL

Alternative 2 comprises the following components: institutional controls including restrictions on land use; excavation and subsequent off-site disposal of coal tar; excavation and subsequent off-site disposal of contaminated soil; and site restoration. Each component associated with this alternative is described in the sections that follow.

4.2.1 Land Use Restrictions

Land use restrictions would be placed on the Site to prohibit the development of the land for unauthorized uses. The current land use is commercial/industrial and the RAOs presented in Section 3 are based on continued commercial/industrial use of the property. The RAOs would have to be reevaluated for residential or recreational use of the property.

4.2.2 Site Preparation

Portions of the coal tar-impacted areas of the Site along the riverbank are heavily vegetated and wooded. To facilitate the soil excavation, existing vegetation would be cleared from the removal area. The aboveground portion of trees and other vegetation would be cut, chipped, and disposed off site at a licensed composting facility or used for on-site landscaping during restoration. It is estimated that 0.5 acre of the Site would require clearing and grubbing. Silt fencing and other engineering controls would be installed or implemented during site preparation activities.

4.2.3 Coal Tar Removal

Delineation Investigation

Prior to excavation activities, a delineation investigation will be performed in the area between KB-113 and TT-107 to determine the extent of coal tar in that area of the Site. A test trench will be dug to approximately 6 ft bgs between KB-113 and TT-107 as shown on **Figure 2-4** to visually inspect for the presence of coal tar.

Coal Tar Removal

Coal tar would be excavated in areas surrounding test pit and boring locations as shown on **Figure 2-4.** These areas are estimated for purposes of this Focused Removal Alternative Evaluation Report. Coal tar areas may be smaller or larger than estimated. However, during the removal action any coal tar identified during the excavation of these areas will be removed until no visually identifiable coal tar product remains. It is assumed that 1 ft of overcut beyond the coal tar areas would be required to remove all known COCs above RISC IDCLs.

The coal tar encountered in the vicinity of TT-101 and KB-101 is estimated to be approximately 0.25 to 1 ft thick starting at a depth of 1 to 1.5 ft bgs. The estimated coal tar-impacted area surrounding TT-101 and the KB-101 step-out borings is 4,800 ft^2. A total of 475 in situ CY of soil would be excavated in the vicinity of TT-101 and KB-101 including an estimated 110 CY of coal tar material and 365 CY of overburden and overcut material. The overburden and overcut material is assumed to contain concentrations of COCs exceeding removal action goals and would require transport and off-site disposal.

The coal tar encountered in the vicinity of TT-107 is estimated to be approximately 4.5 ft thick starting at a depth of 1.5 ft bgs. The estimated coal tar-impacted area surrounding TT-107 is 1,600 ft^2. A total of 415 in situ CY of soil would be excavated in the vicinity of TT-107 including an estimated 270 CY of coal tar material and 145 CY of overburden and overcut material. The overburden and overcut material is assumed to contain concentrations of COCs exceeding removal action goals and would require transport and off-site disposal.

The coal tar encountered within the riverbank is estimated to be approximately 4 ft thick starting at a depth of approximately 2 ft bgs. The estimated coal tar-impacted area of the riverbank is 5,600 ft^2. A total of 1,450 in situ CY of soil would be excavated from the riverbank including an estimated 830 CY of coal tar material, 415 CY of overburden material, and 205 CY of soil to account for a 1-ft assumed overcut. The overburden material from the riverbank is assumed, because of the vegetative growth, to be un-impacted by COCs and would be stockpiled and sampled for COCs. Pending analytical results, the overburden material would either be used for fill on site or disposed off site. For cost-estimating purposes, an estimated 205 CY of overcut material would require transport for off-site disposal in addition to the estimated 830 CY of coal tar.

The coal tar encountered in the vicinity of the KB-113 borings is estimated to be approximately 1 to 2 ft thick starting at a depth of 0.5 to 1 ft bgs. The estimated coal tar-impacted area surrounding KB-113 is 4,000 ft^2. A total of 445 in situ CY of soil would be excavated in the vicinity of KB-113 including an estimated 180 CY of coal tar material and 265 CY of overburden and overcut material. The overburden/overcut material is assumed to contain concentrations of COCs exceeding removal action goals and would require transport and off-site disposal.

A total of 2,785 in situ CY of soil would be excavated from the Site including the 415 in situ CY of overburden material from the riverbank excavation that would be stockpiled on-site. Accounting for +14% for expansion (Sowers, 1979) of the 980 CY of overburden soil assumed to be impacted with COCs and +38% expansion of the 1,390 CY of coal tar material, an estimated 3,035 CY of loose material would require transport and off-site disposal. The volume estimates will be updated pending the results of the delineation investigation. It is estimated that approximately 750 to 1,000 CY of material would be excavated daily.

Coal tar chunks present along the riverbank and near shore (within the river water) of the Wabash River would be picked up and disposed along with the coal tar-impacted soil.

Confirmation Sampling

Following completion of excavation activities and prior to backfilling the excavated areas, confirmation samples would be collected from the excavation bottom and sidewalls. Per IDEM guidance, sidewall samples would be collected at approximate 20-ft spacing along the perimeter of the excavation areas and excavation bottom samples would be collected at a rate of three samples per 0.1 acre of excavation bottom. It is assumed that an additional 10% of the samples taken will be required for quality assurance/quality control (QA/QC). A total of 42 (32 sidewall and 10 excavation bottom) confirmation samples including 10% QA/QC samples would be collected from the riverbank coal tar excavation area. Confirmation samples collected from the test pit and soil boring excavations located in the chip-and-seal area would be collected as part of confirmation sampling of that area and are included in Section 4.2.4. The confirmation samples would be analyzed for BTEX and PAHs. Confirmation sampling results would be compared to IDEM RISC IDCLs. Additional excavation may be warranted if sampling results exceed IDCLs.

Soil Backfilling

Following soil removal and confirmation sampling, the coal tar excavation areas would be backfilled with imported, clean fill. An estimated 2,205 ex situ loose CY of bank run gravel would be delivered to the Site to fill 1,985 CY of excavation areas accounting for lowering the elevation of the Site 6 inches in areas that overlap the chip-and-seal removal area. The 415 CY of staged overburden material would be returned to the riverbank area as a vegetative layer pending analytical results. It is estimated that approximately 750 to 1,000 CY of backfill would be placed per day. Backfilling activities would occur after receipt of confirmation sampling results.

Loading and Transport

The excavated soil and coal tar would be loaded directly or loaded from stockpiles onto dump trucks for transport as a special waste to a local, licensed landfill located approximately 14 miles from the Site. An estimated 3,035 CY of loose material would require transport and off-site disposal. Overall, an estimated 2,990 tons of material would require off-site disposal. The disposal weight was calculated assuming that 1 CY of coal tar is equivalent to 1 ton and 1 CY of overburden soil is equivalent to 1.6 tons. The disposal amount estimates could change depending on the results of the delineation investigation.

An estimated 720 CY of soil would be disposed of per day. Excavated soil would be transported in accordance with applicable and appropriate rules and regulations. It is estimated that 40 truckloads (18 CY per truck) per day would transport the excavated material to the landfill. It is estimated that eight dedicated trucks would be required to complete excavation activities assuming each truck would deliver five loads to the landfill each day. The material transported in the truck to the disposal facility will be covered during transportation. A traffic-control system as well as appropriate signs and housekeeping measures would be implemented during construction activities.

4.2.4 Coal Tar-Impacted Chip and Seal Removal

Excavation

Contaminated soil would be excavated in areas containing coal tar-containing chip and seal in excess of IDEM RISC IDCLs as shown on **Figure 2-4.**

Contaminated soil would be excavated using conventional excavation equipment, such as excavators, bulldozers, and backhoes. The estimated area of coal tar-impacted chip and seal is 146,250 ft^2. Excluding the coal tar areas addressed in Section 4.2.3, the estimated chip and seal-impacted area to be excavated is 135,850 ft^2. Based on an excavation depth of 1 ft bgs, a total of 5,030 in situ CY would be excavated.

Accounting for +14% for expansion, an estimated 5,735 loose CY of loose material would require transport and off-site disposal. It is estimated that approximately 750 to 1,000 CY of soil would be excavated daily. Excavated soil would be direct loaded onto dump trucks for transport to the disposal facility. A soil staging area would be constructed at the Site, as necessary.

Confirmation Sampling

Following completion of excavation activities and prior to backfilling the excavated areas, confirmation samples would be collected from the excavation bottom and sidewalls. Per IDEM guidance, sidewall samples would be collected at approximate 20-ft spacing and excavation along the perimeter of the excavation area and excavation bottom samples would be collected at a rate of 10 samples per 0.5 acre of excavation bottom. A total of 248 (174 sidewall and 74 excavation bottom) confirmation samples, including 10% QA/QC samples, would be collected from the coal tar-impacted chip-and-seal excavation area. The confirmation samples would be analyzed for PAHs. Confirmation sampling results would be compared to IDEM RISC IDCLs. Additional excavation may be warranted if sampling results exceed IDCLs.

Soil Backfilling

Following soil removal and confirmation sampling, the excavation would be backfilled with 6 inches of imported, clean topsoil. The elevation of the Site would be lowered approximately 6 inches. Accounting for +15% for compaction (Sowers, 1979), an estimated 3,115 CY of loose topsoil would require transport to the Site for use as backfill material. It is estimated that approximately 750 to 1,000 CY of soil would be backfilled daily. Backfilling activities would occur after receipt of confirmation sampling results.

Loading and Transport

The excavated soil would be loaded directly onto dump trucks for transport to a local, licensed landfill as a special waste. The disposal facility is approximately 14 miles from the Site. An estimated 5,735 CY of loose material would require transport and off-site disposal. Assuming that 1 CY of soil is equivalent to 1.62 tons, 8,150 tons of material would require off-site disposal.

An estimated 720 tons of soil would require disposal per day. Excavated soil would be transported in accordance with applicable and appropriate rules and regulations. It is estimated that 40 truckloads (18 CY per truck) per day would transport the excavated material to the landfill. It is estimated that eight dedicated trucks would be required to complete excavation activities assuming each truck would deliver five loads to the landfill each day. The material transported in the truck to the disposal facility will be covered during transportation. A traffic-control system as well as appropriate signs and housekeeping measures would be implemented during construction activities.

4.2.5 Controls and Worker Safety

Special controls would be implemented during excavation and backfilling activities to minimize environmental releases and to protect worker and public safety. Some of the controls would include the following:

- Using appropriate dust control measures, such as water trucks to wet down the excavated areas.

- Establishing equipment decontamination areas to prevent off-site migration of contaminants.
- Continuous monitoring at Site boundaries for particulates during construction activities.
- Following appropriate health and safety precautions.

4.2.6 Site Restoration

The excavated areas would be seeded and mulched for revegetation at the completion of construction activities. The actual riverbank restoration will be determined during the preparation of the Site Erosion Control Plan.

4.2.7 Estimated Time to Achieve Soil Remediation Objectives

An estimated 3 days would be required for mobilization and site preparation activities. An estimated 10 days would be required for excavation activities based on an estimated 750 to 1,000 CY of soil being moved daily. Backfilling and loading and transport activities would occur concurrently with a 5-day lag to allow for receipt and evaluation of confirmation analytical results for the soil samples collected from the excavations. Site restoration, post-construction surveying, and demobilization would require 3 days.

As such, activities are estimated to be complete in approximately 6 weeks based on a 5-day work week.

4.3 ALTERNATIVE 3 – CONTAINMENT, ASPHALT ENGINEERED BARRIER

Alternative 3 comprises the following components: institutional controls including restrictions on land use; excavation and subsequent off-site disposal of coal tar; and installation of an asphalt engineered barrier over the coal tar-impacted chip-and-seal area; and site restoration. Each component associated with this alternative is described in the sections that follow.

4.3.1 Land Use Restrictions

The land use restrictions for this alternative would be the same as described in Alternative 2.

4.3.2 Coal Tar Removal

The coal tar excavation and disposal for this alternative would be the same as described in Alternative 2 except for the number of confirmation samples. A total of 94 confirmation samples including the 42 (32 sidewall and 10 excavation bottom) from the riverbank coal tar excavation area and 52 (42 sidewall and 10 excavation bottom) from the test pit and soil boring excavations would be collected for PAH analysis.

4.3.3 Engineered Barrier - Asphalt

An asphalt cap would be designed to create a barrier to prevent direct contact, ingestion, and inhalation. The asphalt cap would not be designed to prevent infiltration because all COCs above RISC migration to groundwater levels would be removed from the chip-and-seal area during the coal tar removal activities. The engineered barrier would comprise 4 inches of asphalt.

The area to be capped would include an estimated 146,250 ft^2 or 16,250 square yards (SY).

4.3.4 Operations and Maintenance of Engineered Barriers

Long-term maintenance would be required for the asphalt cap proposed in this alternative. The fulfillment of remediation objectives developed for the Site is dependent upon site conditions and the maintenance of existing engineered barriers. Maintenance would be required to repair potential cracks and weathering in the asphalt or concrete. The integrity of the barrier would be inspected yearly for 5 years. Reevaluation of the remedy would occur after 5 years. Depending on the intensity of use of the asphalt area (parking lot, etc.), the barrier may require replacement every 5 to 10 years.

4.3.5 Site Restoration

The excavated areas would be seeded and mulched for revegetation at the completion of construction activities. The actual riverbank restoration will be determined during the preparation of the Site Erosion Control Plan.

4.3.6 Estimated Time to Achieve Soil Remediation Objectives

An estimated 3 days would be required for mobilization and site preparation activities. An estimated 12 days would be required for excavation and backfilling activities based on an estimated 750 to 1,000 CY of soil being moved daily. Backfilling and loading and transport activities would occur concurrently with a 3- to 5-day lag to allow for receipt and evaluation of confirmation analytical results for the soil samples collected from the excavations.

Approximately 4 days would be required for constructing the asphalt cap based on daily application of 4;140 SY of asphalt. Site restoration, post-construction surveying, and demobilization would require 3 days. As such, activities are estimated to be complete in approximately 6 weeks based on a 5-day work week with 1 day per week allowed as a rain day.

4.4 ALTERNATIVE 4 – CONTAINMENT, SOIL ENGINEERED BARRIER

Alternative 4 comprises the following components: institutional controls including restrictions on land use; excavation and subsequent off-site disposal of coal tar; and installation of a soil engineered barrier over coal tar-impacted chip-and-seal area; and site restoration. Each component associated with this alternative is described in the sections that follow.

4.4.1 Land Use Restrictions

The land use restrictions for this alternative would be the same as described in Alternative 2.

4.4.2 Coal Tar Removal

The coal tar excavation and disposal for this alternative would be the same as described in Alternative 3.

4.4.3 Engineered Barrier – Soil

An earthen cap would be used to create a barrier to prevent direct contact, ingestion, and inhalation and to limit migration of contaminants of concern in soil to groundwater. The engineered barrier would comprise 18 inches of general fill overlain by 6 inches of topsoil.

The area to be capped would include an estimated 146,250 ft^2. Accounting for +12% for general fill compaction (Sowers, 1979), an estimated 8,455 CY of loose, general fill cover material would be delivered to the Site. In addition, an estimated 3,115 CY of loose topsoil would require transport to the Site for use as backfill material accounting for +15% for compaction. It is estimated that approximately 750 to 1,000 CY of soil would be placed and compacted daily.

4.4.4 Operations and Maintenance of Engineered Barriers

Long-term maintenance would be required for the soil cap proposed in this alternative. This would entail mowing the soil cap a minimum of twice a year, weed removal, and repair of any erosion. The fulfillment of removal action objectives developed for the Site is dependent upon Site conditions and the maintenance of existing engineered barriers. The integrity of the barrier would be inspected yearly for 5 years. Reevaluation of the remedy would occur after 5 years.

4.4.5 Site Restoration

The excavated areas would be seeded and mulched for revegetation at the completion of construction activities. The actual riverbank restoration will be determined during the preparation of the Site Erosion Control Plan.

4.4.6 Estimated Time to Achieve Soil Remediation Objectives

An estimated 3 days would be required for mobilization and site preparation activities. An estimated 12 days would be required for excavation and backfilling activities based on an estimated 750 to 1,000 CY of soil being moved daily. Backfilling and loading and transport activities would occur concurrently with a 3- to 5-day lag to allow for receipt and evaluation of confirmation analytical results for the soil samples collected from the excavations.

Approximately 8 days would be required for constructing the soil cap based on 750 to 1,000 CY of soil placed and compacted daily. Site restoration, post-construction surveying, and demobilization would require 3 days.

As such, activities are estimated to be complete in approximately 6 weeks based on a 5-day work week including one rain day per week.

4.5 ALTERNATIVE 5 – THERMAL TREATMENT

Alternative 5 consists of ex situ treatment and includes the following components: institutional controls including restrictions on land use; excavation and subsequent off-site disposal of coal tar; ex situ thermal treatment of coal tar-impacted chip and seal; and site restoration. Each component associated with this alternative is described in the sections that follow.

4.5.1 Land Use Restrictions

The land use restriction for this alternative would be the same as that described in Alternative 2.

4.5.2 Coal Tar Removal

The coal tar excavation and disposal for this alternative would be the same as that described in Alternative 2.

4.5.3 Soil Excavation

The excavation procedures outlined for Alternative 2 would be followed for soil excavation. Contaminated soil above RISC IDCLs would be excavated using conventional excavation equipment, such as excavators, bulldozers, and backhoes. The areas of the Site that would require excavation are shown on **Figure 2-4**. The estimated area and volume of excavation for the chip-and-seal impacted area is presented in Alternative 2.

Once excavated, contaminated soils may be staged in a designated staging area in preparation for thermal treatment or may be treated continuously as excavated from the site.

4.5.4 Thermal Desorption

Thermal desorption treats contaminated soil by heating the soil to a target temperature to cause organic contaminants to volatilize. Vapors from thermal desorption are treated by filtration, wet scrubbing, vapor-phase carbon adsorption, or thermal oxidation. Thermal desorption units are available in mobile, completely self-sufficient units that run on natural gas or propane. A variety of conventional industrial equipment can be used for thermal desorption. Indirectly heated systems include rotary calciners heated indirectly by a furnace, hollow-flight thermal screw processors heated by steam or hot oil, and moving bed units that use infrared heat. An estimated 5,030 CY (8,150 tons) of soil would require thermal treatment.

Following thermal treatment, the soil would exit the thermal unit and be transferred by a conveyor or front-end loader to a temporary stockpile location. Soil would be stockpiled in defined volumes and sampled to determine the treatment efficiency of the thermal treatment unit. Once sampled, the soil would be temporarily covered with a polyethylene tarpaulin to limit wind erosion and infiltration of precipitation until sampling results are received. Upon receipt of the appropriate sampling results, the treated soils would be returned to the excavation areas.

4.5.5 Site Restoration

The treated soil areas would be seeded and mulched for revegetation at the completion of construction activities.

4.5.6 Estimated Time to Achieve Soil Remediation Objectives

An estimated 3 days would be required for mobilization and site preparation activities. An estimated 10 days would be required for excavation activities based on an estimated 750 to 1,000 CY of soil being moved daily. Backfilling and loading and transport activities would occur concurrently with a 5-day lag to allow for receipt and evaluation of confirmation analytical results for the soil samples collected from the excavations.

Based on a treatment rate of 650 to 750 tons per day, a total of 12 days would be required for thermal treatment. Following treatment, it is estimated that 5 days would be required for backfilling activities. Site restoration, post-construction surveying, and demobilization would require 3 days. As such, activities are estimated to be complete in approximately 7 weeks based on a 5-day work week including an estimated 1-day standby time per week due to rain.

5. SCREENING OF ALTERNATIVES

This section presents the screening of alternatives for the Site. The screening evaluates the developed alternatives in regard to their effectiveness, implementability, and cost.

Effectiveness Criterion

This criterion is used to evaluate the effectiveness of the alternatives for attaining the RAOs. Each alternative is also evaluated based on its effectiveness for reducing the toxicity, mobility, or volume of the soil contaminants. Both short- and long-term components of effectiveness are evaluated: short-term effectiveness refers to the construction and implementation period; long-term effectiveness refers to the period after the removal action is complete. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristics of the contaminated media through the use of treatment that decreases the inherent threats or risks associated with the contaminated material.

Implementability Criterion

The implementability criterion is used to evaluate each alternative with respect to its technical and administrative feasibility and the availability of necessary technologies and services. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific regulations for process options. Administrative feasibility refers to the ability to obtain approvals from other offices and agencies; the availability of treatment, storage, and disposal services and their capacity; and the requirements for and availability of specific equipment and technical specialists.

Cost Criterion

The cost criterion is a general cost analysis used to identify alternatives that are significantly more costly than other alternatives achieving the same level of effectiveness. Cost estimates for the alternatives were prepared primarily by contacting potential materials suppliers and other contractors and by using construction estimating resources. The costs were estimated from the information available at the time of the estimate. Whenever possible, more than one supplier was contacted to estimate the costs; therefore, the costs will be within the desired range of accuracy of +50 to -30% of the actual final cost. Final costs will depend on actual labor and material costs, actual site conditions, market conditions, final project scope, final project schedule, productivity, and other variable factors. As a result, the final costs will vary from the estimates presented in this report; however, most of these factors should not affect the relative cost differences between the alternatives.

Total capital costs consist of the direct and indirect costs required to initiate and implement a removal action. Direct costs include costs for construction, labor, and materials. Indirect costs consist of engineering, permitting, supervising, and other similar services. Construction contingencies account for unknown costs. Unknown costs include a variety of factors that would tend to increase costs associated with a given project scope, such as bidding climate, adverse weather conditions, availability of materials, contractors' uncertainty regarding liability and insurance, regulatory or policy changes that may affect assumptions, and geotechnical unknowns. Contingencies do not include allowances for price inflation and unforeseeable, abnormal technical difficulties.

Screening of the alternatives is discussed in the sections that follow.

5.1 ALTERNATIVE 1 - NO ACTION

Alternative 1 consists of no action. The no action alternative is retained because it provides a baseline for comparison with other alternatives. Alternative 1 is evaluated based on effectiveness, implementability, and cost as described in the sections that follow.

5.1.1 Effectiveness

This alternative would not be effective in protecting human health and the environment or reducing the toxicity, mobility, or volume of the soil contaminants. Alternative 1 will not meet the RAOs. This alternative is effective in the short-term because the Site does not pose an imminent threat to human health or the environment. Current site risks are manageable without action if additional time is required to select or evaluate alternatives; however, this alternative does not offer long-term effectiveness and permanence because no removal action is implemented.

5.1.2 Implementability

Alternative 1 would be easily implemented because there are no associated activities to perform.

5.1.3 Cost

No cost is associated with Alternative 1 because no removal action activities would be implemented at the Site.

5.2 ALTERNATIVE 2 – EXCAVATION AND OFF-SITE DISPOSAL

Alternative 2 consists of institutional controls including restrictions on land use; excavation and subsequent off-site disposal of coal tar; excavation and subsequent off-site disposal of contaminated soil; and site restoration. Alternative 2 is evaluated based on effectiveness, implementability, and cost as described in the sections that follow.

5.2.1 Effectiveness

Land use restrictions would be placed on the Site to limit its use for commercial/industrial purposes. Institutional controls are effective in limiting exposure; however, the effectiveness of these controls is based on enforcement.

Removal and off-site disposal of the coal tar and coal tar-impacted chip-and-seal soil would protect human health and the environment by eliminating the health risks such as direct contact with, ingestion, and inhalation associated with exposure to the contaminants present within soil at the Site. Removal and off-site disposal of the contaminated soil would also prevent impact to natural resources by eliminating the possibility of migration of coal tar to the Wabash River and lateral migration of contaminated soil to downgradient areas and nearby surface water bodies. Excavation of the contaminated soils also eliminates the potential of soil contaminants to migrate downward into the underlying aquifer.

Although this alternative removes contaminated soil from the Site, it does not reduce the volume, mobility, or toxicity of the contaminants; it simply transfers the contaminants from the area of contamination to an off-site location.

Short-term risks would be posed to the surrounding community and the on-site workers because of dust inhalation and ingestion; however, particulate emissions could be minimized using dust suppression measures. Additional short-term risks would be posed because of vehicular traffic for both hauling the contaminated soil to a landfill and delivering the backfill to the Site.

5.2.2 Implementability

Land use restrictions would be relatively easy to implement. The technologies associated with this alternative are proven, well-known technologies that are relatively easy to implement. Materials and equipment are readily available in the region. Since this alternative involves excavation, the ease of this alternative's implementability is dependent upon the ease of excavation of the contaminated soil. Excavation may be somewhat difficult for the coal tar removal because of the proximity to the Wabash River. The Site is currently vacant, so implementation of the alternative will not interfere with any Site operations.

If fugitive dust emissions are a problem during implementation, dust suppression measures are readily available and easily implemented. Overall, site restoration would be easy.

5.2.3 Cost

As presented in **Appendix B,** construction costs with 20% contingency and excluding professional services would be approximately $705,500.

5.3 ALTERNATIVE 3 – CONTAINMENT, ASPHALT ENGINEERED BARRIER

Alternative 3 consists of institutional controls including restrictions on land use; excavation and subsequent off-site disposal of coal tar; installation of an asphalt engineered barrier over coal tar-impacted chip-and-seal area; and site restoration. Alternative 3 is evaluated based on effectiveness, implementability, and cost as described in the sections that follow.

5.3.1 Effectiveness

Land use restrictions would be placed on the Site to limit its use for commercial/industrial purposes. Institutional controls are effective in limiting exposure; however, the effectiveness of these controls is based on enforcement.

Removal and off-site disposal of the contaminated coal tar-impacted soil would protect human health and the environment by eliminating the health risks such as direct contact with, ingestion, and inhalation associated with exposure to the contaminants. Removal and off-site disposal would also prevent impact to natural resources by eliminating the possibility of migration of coal tar to the Wabash River. Although this alternative removes coal tar material from the Site, it does not reduce the volume, mobility, or toxicity of the contaminants; it simply transfers the contaminants from the area of contamination to an off-site location.

In-place containment is a commonly used, proven technology. This alternative would achieve RAOs by covering contaminated soils in place thereby eliminating the exposure pathway. Containment of the contaminated soil by use of an engineered barrier over the contaminated soil would protect human health and the environment by eliminating the health risks such as direct contact with, ingestion, and inhalation associated with exposure to the contaminants present within soil at the Site. Placement of an engineered barrier over the contaminated soil would also prevent soil erosion and minimize impact to natural resources.

Although implementation of this alternative would reduce the mobility of Site contaminants, it does not reduce the volume or toxicity of the contaminants. Repaving and maintaining the integrity of the existing engineered barrier will mitigate exposure risks associated with impacted soils left in place at the Site.

5.3.2 Implementability

Land use restrictions would be relatively easy to implement. The technologies associated with this alternative are proven, well-known technologies that are relatively easy to implement. Materials and equipment are readily available in the region. Excavation and grading of the soil surface for coal tar removal may pose short-term disruption to the community because of truck traffic and potential dust generation.

5.3.3 Cost

As presented in **Appendix B**, construction costs with 20% contingency per EPA guidance and excluding professional services would be approximately $593,000.

5.4 ALTERNATIVE 4 – CONTAINMENT, SOIL ENGINEERED BARRIER

Alternative 4 consists of institutional controls including restrictions on land use; excavation and subsequent off-site disposal of coal tar; and installation of a soil engineered barrier over coal tar-impacted chip-and-seal area; and site restoration. Alternative 4 is evaluated based on effectiveness, implementability, and cost as described in the sections that follow.

5.4.4 Effectiveness

Land use restrictions would be placed on the Site to limit its use for commercial/industrial purposes. Institutional controls are effective in limiting exposure; however, the effectiveness of these controls is based on enforcement.

Removal and off-site disposal of the contaminated coal tar-impacted soil would protect human health and the environment by eliminating the health risks, such as direct contact with, ingestion, and inhalation associated with exposure to the contaminants. Removal and off-site disposal would also prevent impact to natural resources by eliminating the possibility of migration of coal tar to the Wabash River. Although this alternative removes coal tar material from the Site, it does not reduce the volume, mobility, or toxicity of the contaminants; it simply transfers the contaminants from the area of contamination to an off-site location.

In-place containment is a commonly used, proven technology. This alternative would achieve RAOs by covering contaminated soils in place thereby eliminating the exposure pathway and minimizing infiltration to mitigate the migration to groundwater pathway. Containment of the contaminated soil by use of an engineered barrier over the contaminated soil would protect human health and the environment by eliminating the health risks, such as direct contact with, ingestion, and inhalation associated with exposure to the contaminants present within soil at the Site. Placement of an engineered barrier over the contaminated soil would also prevent soil erosion and minimize impact to natural resources. Use of an engineered barrier also reduces the potential of soil contaminants to migrate downward into the underlying aquifer.

Although implementation of this alternative would reduce the mobility of Site contaminants, it does not reduce the volume or toxicity of the contaminants. Maintaining the integrity of the soil engineered barrier will mitigate exposure risks associated with impacted soils left in place at the Site.

5.4.5 Implementability

Land use restrictions would be relatively easy to implement. The technologies associated with this alternative are proven, well-known technologies that are relatively easy to implement. Materials and equipment are readily available in the region. Excavation and grading of the soil surface for coal tar removal and soil cap placement may pose short-term disruption to the community because of truck traffic and potential dust generation.

5.4.6 Cost

As presented in **Appendix B**, construction costs with 20% contingency per EPA guidance and excluding professional services would be approximately $525,800.

5.5 ALTERNATIVE 5 – THERMAL TREATMENT

Alternative 5 consists of institutional controls including restrictions on land use; excavation and subsequent off-site disposal of coal tar; ex situ thermal treatment of coal tar-impacted chip and seal; and site restoration. Alternative 5 is evaluated based on effectiveness, implementability, and cost as described in the sections that follow.

5.5.1 Effectiveness

Land use restrictions would be placed on the Site to limit its use for commercial/industrial purposes. Institutional controls are effective in limiting exposure; however, the effectiveness of these controls is based on enforcement.

Removal and off-site disposal of the contaminated coal tar-impacted soil would protect human health and the environment by eliminating the health risks such as direct contact with, ingestion, and inhalation associated with exposure to the contaminants. Removal and off-site disposal would also prevent impact to natural resources by eliminating the possibility of migration of coal tar to the Wabash River. Although this alternative removes coal tar material from the Site, it does not reduce the volume, mobility, or toxicity of the contaminants; it simply transfers the contaminants from the area of contamination to an off-site location.

Thermal desorption is a proven technology effective for many organic chemicals. A complete chemical characterization would be provided to determine optimal temperatures for thermal desorption. Additional data would be analyzed prior to implementation to predict whether thermal desorption may generate harmful by-products, that could require additional management.

Thermal desorption vendors have extensive quality controls in place. Data can be logged every 5 minutes of operation, and frequent samples are collected from the treated material. An optimistic but technically feasible rate for thermal desorption treatment is 650 to 750 tons of soil per day.

The contaminated soil would be treated such that the toxicity and mobility of the contaminants is greatly reduced. This would further ensure long-term effectiveness of the alternative at preventing off-site migration of chemicals.

5.5.2 Implementability

Implementability would depend on the type of equipment and/or vendors selected to complete the project. The contaminated soil may need to be handled multiple times to attain RAOs thereby increasing the complexity of the project. The amount of time needed to complete soil treatment increases the duration of short-term nuisances for the community.

5.5.3 Cost

As presented in **Appendix B**, construction costs with 20% contingency and excluding professional services would be approximately $1,497,000.

6. REFERENCES

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TABLE

FIGURES

APPENDIX A
PHOTOGRAPHIC LOG

APPENDIX B
DETAILED COST TABLES